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1256419

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(54) IMPROVEMENTS IN AND RELATING TO METAL/OXYGEN CELLS

(71) We, ENERGY CONVERSION LIMITED, a British Company of Priestly Road, Basingstoke, Hampshire (formerly of Britannic House, Moor Lane, London, E.C.2), do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to electrochemical cells and more particularly to primary metal/oxygen cells.

According to one aspect of the invention there is provided a primary metal/oxygen cell in which the anode is apertured to provide a reservoir which contains electrolyte for the cell but does not contain the cathode.

According to a further aspect of the invention there is provided a primary metal/oxygen cell comprising a tubular anode electrode which has a cathode electrode located therearound, the internal space of the tubular anode electrode being utilised as an electrolyte reservoir.

Preferably the spacing between the anode and cathode electrodes are at a minimum as determined by a separator positioned therebetween.

The anode and cathode electrodes and the separator may be cylindrical, have elliptical transverse cross-section or may have plane major faces with semi-cylindrical edge portions.

The anode electrode may be formed with a plurality of apertures for use as electrolyte reservoirs.

At least one of the apertures or the aperture in the anode electrode may have a current collector in electrical contact with the inside wall thereof. When the aperture is cylindrical the current collector is preferably in the form of a helix which engages or is embedded in the inside surface of such anode.

In an alternative arrangement the aperture may have a current collector therein which partitions such aperture to provide both electrolyte reservoir space and further separate space which may be utilised for flow of a cooling medium therethrough. The aperture may be formed with splines with the current collector in the form of a rod or cylindrical sheet-form member engaging the splines to partition the aperture.

At least one end cap is provided which may be electrically insulating material, such as synthetic plastics, which carries an electrically conductive member, such as a rivet, electrically connected to one of the electrodes. The cathode electrode may be sealed to the or each end cap.

A perforated outer cover may be provided to allow access for air to the cathode.

Such outer cover may be fixed between the end caps by an adhesive, be heat sealing or by crimping. The outer cover may be fabricated of metal and may extend around one end of the cell. In this arrangement one of the electrode may be electrically connected to the outer cover.

The foregoing and further features of the invention may be more readily understood from the following description of some preferred embodiments thereof, by way of example, with reference to the accompanying drawings, in which:—

Fig. 1 is a side sectional view through half of a primary metal/oxygen cell;

Fig. 2 is a plan view of an alternative arrangement of a primary metal/oxygen cell;

Fig. 3 is a plan view of a further alternative arrangement of a primary metal/oxygen cell, and

Fig. 4 is a plan view if yet a further alternative arrangement of a primary metal/oxygen cell.

Referring firstly to Fig. 1 there is shown a side sectional view through half a metal/oxygen cell, the half not shown being a mirror image of the illustrated half.

The cell comprises a cylindrical anode electrode 11, the inner central aperture 11a of which serves as a reservoir for the elec-

trolyte of the cell. A separator 12 in the form of a cylindrical bag extends all around the anode except above the aperture 11a at the top of the cell. End caps 13 are located at the top and bottom of the cell and a cylindrical sheet-form cathode electrode 14 surrounds the vertical extent of the separator 12 and is sealed to the end caps 13.

The anode 11 may be fabricated of porous zinc with mercury added; the separator 12 may be formed of foraminous P.V.C., polypropylene or material sold under Registered Trade Mark Cellophane; the end caps 13 may be fabricated of a synthetic plastics material and the cathode comprises a hydrophobic layer and a catalyst. The electrolyte for use with such a cell would be an aqueous solution of potassium hydroxide.

A perforated cylindrical outer cover 15 surrounds the cathode 14 and allows the ingress of air to the cathode to facilitate depolarisation. The cover 15 may be made of metal and extends between the end cap 13 to which it is fixed by an adhesive, heat sealing or crimping. In an alternative arrangement (not shown) the cover 15 also extends around the bottom of the cell and the lower end cap 13 is then dispensed with.

A rivet 16, of copper or brass, is rivetted to each of the end caps 13, a metal strengthening washer 17 being located adjacent the rivet 16 on the outer surface of the end cap 13 and a sealing washer 18 being located adjacent the rivet 16 on the inner surface of end cap 13. A helical current collector 19 which may be of copper or brass, is engaged with, or embedded in, the wall of aperture 11a and is engaged with the upper rivet 16 to provide external connection from the anode 11. An electrical lead 20 is connected from the cathode 14 to be bottom rivet 16 to provide external connection from the cathode 14. When the lower end cap is not provided one of the electrodes can be connected to the outer cover 15 and the other to the rivet 16 in the top end cap 13.

A cell as illustrated in Fig. 1 has been built and tested and found to operate successfully. Such a cell would be suitable for powering a small electrical device such as a battery operable shaver.

Referring now to Fig. 2, there is shown a plan view of a primary metal/oxygen cell similar to that of Fig. 1. In Fig. 2 the end cap has been omitted to more clearly illustrate the difference between this cell and that shown in Fig. 1. In the Fig. 2 cell the anode current collector 19′ comprises a sheet member having generally cruciform transverse cross-section. In this manner the current collector 19′ constitutes a partition to provide four spaces 11a′ to accommodate electrolyte and a central space 11b. The central space 11b can be utilised to allow passage of a cooling medium, such as air, to pass through the centre of the cell.

Referring now to Fig. 3 there is shown a plan view, similar to that of Fig. 2, of a further alternative arrangement of anode and anode current collector in a primary metal/oxygen cell. In this arrangement the aperture in the anode 11 is formed with internally extending splines 11c which engage with a rod-form or cylindrical current collector 19″. In this way four spaces 11a″ are provided to accommodate electrolyte and a solid current collector 19″ can be provided or a cylindrical current collector to allow passage of a cooling medium.

Referring finally to Fig. 4, there is shown a plan view, similar to that of Figs. 2 and 3, of a further alternative arrangement of a primary metal/oxygen cell. In this arrangement the central electrolyte reservoir aperture 19 is replaced by a number of separate apertures 21.

In each of the arrangements described, the electrolyte may be in free form, may be gelled or may be absorbed in a wick (not shown). It will be noted that in each arrangement "free" electrolyte is spaced a substantial distance from the cathode. Although the spacing between anode, separator and cathode is shown relatively large for clarity, in practice the anode would be a press fit in the cathode/separator so maintaining the clearance therebetween at a minimum to reduce volts drop in the cell.

Oxygen for depolarisation of the cell may be derived from air.

WHAT WE CLAIM IS:—

1. A primary metal/oxygen cell in which the anode is apertured to provide a reservoir which contains electrolyte for the cell but does not contain the cathode.

2. A primary metal/oxygen cell comprising a tubular anode electrode which has a cathode electrode located therearound, the internal space of the tubular anode electrode being utilised as an electrolyte reservoir.

3. A primary cell as claimed in claim 2 wherein the spacing between the anode and cathode electrodes are at a minimum as determined by a separator positioned therebetween.

4. A primary cell as claimed in claim 3 wherein the anode and cathode electrodes and the separator are cylindrical, have elliptical transverse cross-section, or have plane major faces with semi-cylindrical edge portions.

5. A primary cell as claimed in any preceding claim formed with a plurality of apertures for use as electrolyte reservoirs.

6. A primary cell as claimed in any preceding claim wherein at least one of the apertures or the aperture in the anode electrode has a current collector in electrical contact with the inside wall thereof.

7. A primary cell as claimed in claim 6

wherein the aperture(s) is/are cylindrical and the current collector is in the form of a helix which engages or is embedded in the inside surface of such anode.

8. A primary cell as claimed in claim 6 wherein the current collector is such that it partitions the aperture to provide both electroylte reservoir space and further separate space which can be utilised for flow of a cooling medium therethrough.

9. A primary cell as claimed in claim 6 wherein the aperture is formed with splines with the current collector in the form of a rod or cylindrical sheet-form member engaging the splines to partition the aperture.

10. A primary cell as claimed in any preceding claim having at least one end cap of electrically insulating material which carries an electrically conductive member electrically connected to one of the electrodes.

11. A primary cell as claimed in claim 10 wherein the cathode electrode is sealed to the or each end cap.

12. A primary cell as claimed in any preceding claim including a perforated outer cover to allow access for air to the cathode.

13. A primary cell as claimed in claim 12 wherein the outer cover is fixed to the end cap or between each of the end caps by an adhesive, by heat sealing or by crimping.

14. A primary cell as claimed in claim 12 or 13 wherein the outer cover is fabricated of metal and extends around one end of the cell.

15. A primary cell as claimed in claim 14 wherein one of the electrodes is electrically connected to the outer cover.

16. A primary metal/oxygen cell substantially as hereinbefore decribed with reference to Fig. 1 of the accompanying drawings.

17. A primary metal/oxygen cell substantially as hereinbefore described with reference to Fig. 2 of the accompanying drawings.

18. A primary metal/oxygen cell substantially as hereinbefore described with reference to Fig. 3 of the accompanying drawings.

19. A primary metal/oxygen cell substantially as hereinbefore described with reference to Fig. 4 of the accompanying drawings.

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1256419 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

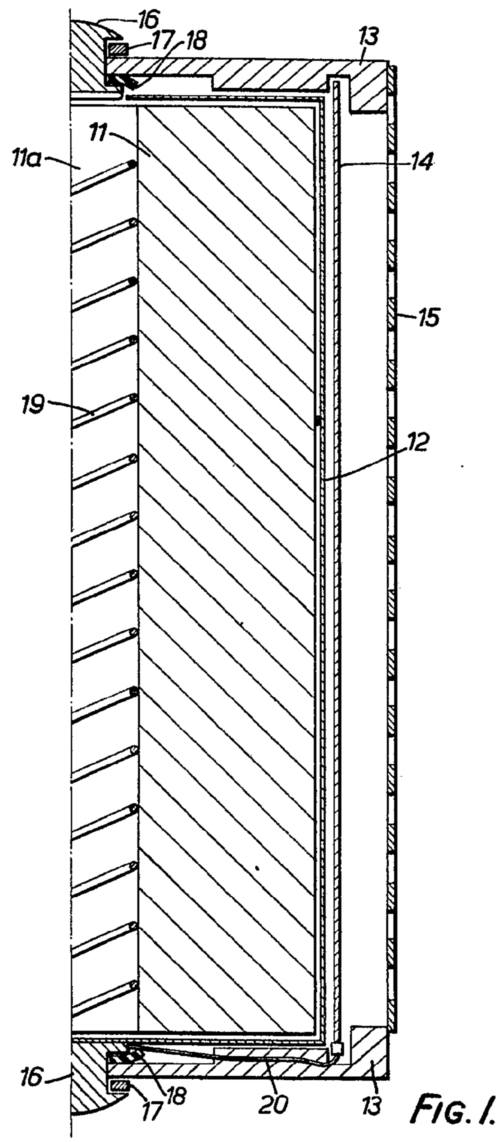

FIG. 1.

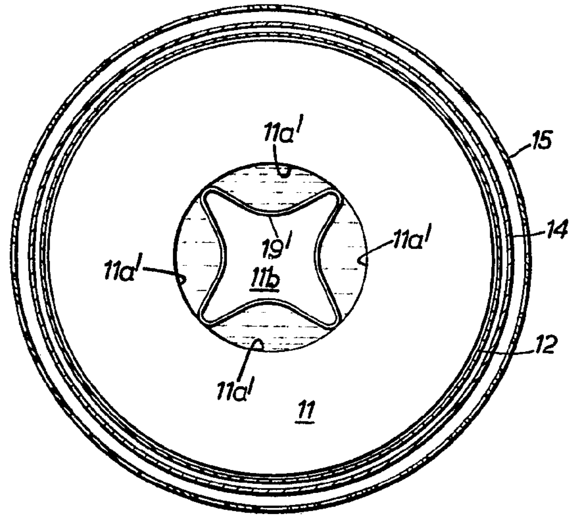

FIG. 2.

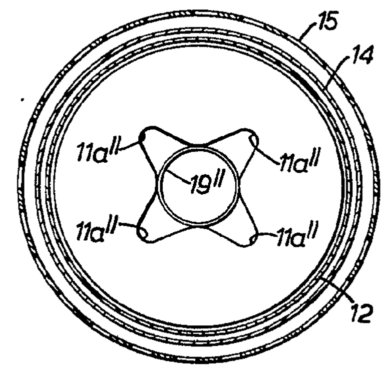

FIG. 3.

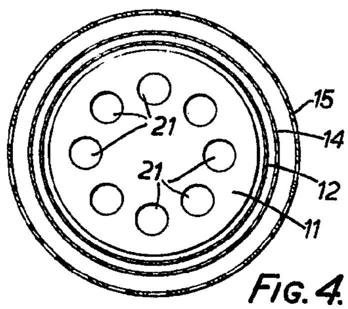

FIG. 4.